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Research Article

A COMPARATIVE STUDY OF DEXMEDETOMIDINE AND CLONIDINE AS AN ADJUVANT TO ROPIVACAINE IN SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK

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ABSTRACT

Objectives: Ultrasound-guided supraclavicular brachial plexus block is the most commonly performed approach for the upper limb surgeries and perioperative pain relief. This study was conducted to compare the post-operative analgesic efficacy of dexmedetomidine and clonidine as an adjuvant to ropivacaine in supraclavicular brachial plexus block in patients undergoing upper limb surgeries.

Methods: This was a prospective, randomized, and double-blinded comparative research that included 60 ASA PS I and II patients who were scheduled for the upper limb surgery. The patients were randomized into two groups, namely, Group C and Group D, with 30 patients each. The patients in Group D were given USG-guided supraclavicular brachial plexus block with 30 ml of 0.5% ropivacaine and dexmedetomidine 1 μg/kg and patients in Group C received 30 ml of 0.5% ropivacaine and clonidine 1 μg/kg. The patients were monitored for post-operative and interpreted by visual analog score and duration of analgesia. The Student's independent t-test was employed for comparing continuous variables. Chi-square test or Fisher's exact test, whichever is appropriate, was applied for comparing categorical variables.

Results: The mean duration of analgesia was longer and the mean consumption of rescue analgesics was lower in Group D as compared to Group C. No significant post-operative complications or local side effects related to the block were noted.

Conclusion: Dexmedetomidine prolongs the duration of sensory and motor block as well as the duration of post-operative analgesia as compared to clonidine when used as an adjuvant to ropivacaine in supraclavicular brachial plexus block.

Keywords: Supraclavicular brachial plexus block, Dexmedetomidine, Clonidine, Ropivacaine, postoperative analgesia.

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INTRODUCTION

The upper limb surgical procedures are primarily completed beneath peripheral blocks which include the brachial plexus block. There are various techniques for blocking the nerves of the brachial plexus which are classified by the level at which the needle or catheter is inserted for injecting the local anesthetic. Brachial plexus block was first performed by Halsted in 1884 [1,2]. The supraclavicular approach to brachial plexus blockade was introduced in clinical practice in Germany by Kulenkampff in 1911 [3]. The supraclavicular approach gives the most effective block for all portions of the upper extremity and is performed at the trunk level where the plexus is presented most compactly, resulting in a homogeneous spread of anesthetic drug throughout the plexus with fast onset and complete block. However, these early advantages are short-lived and limited by the relatively brief duration of action of currently available local anesthetics (LAs), which results in block resolution before the period of worst post-operative pain. Increasing the volume (dose) of LAs may additionally lengthen the duration of analgesia, but might also extend the hazard of Las systemic toxicity. Although non-stop catheter-based nerve blocks can increase post-operative analgesia, their placement calls for extra time, price, and talent. Hence, various adjuvants were used to prolong the period of analgesia of nerve blocks, for example, buprenorphine, fentanyl, magnesium, dexamethasone, midazolam, neostigmine, etc., but they all are associated with more or fewer side effects. There has always been a search for an adjuvant to the regional nerve block with drugs that prolong the duration of analgesia but with lesser adverse effects [4]. Alpha-2 adrenergic receptor agonists such as clonidine and dexmedetomidine have been the focus of interest during anesthesia for their sedative, analgesic, perioperative sympatholytic, and cardiovascular stabilizing effects with reduced anesthetic requirements [5]. Dexmedetomidine is a highly selective and specific α2 adrenoreceptor agonist. Dexmedetomidine has a 2:1 selectivity that is 8 times higher than clonidine, and its high specificity for the α2 subtype makes it more effective as a sedative and analgesic. Dexmedetomidine has also been shown to prolong the duration of block and post-operative analgesia when added to local anesthetics in various regional blocks [6]. Ropivacaine is a local anesthetic that is made from the "S" enantiomer of bupivacaine. Ropivacaine is less lipophilic than bupivacaine and is less likely to penetrate large myelinated motor fibers, resulting in a relatively reduced motor blockade. It is less cardiotoxic, less arrhythmogenic, and less toxic to the central nervous system than bupivacaine, and it also has intrinsic vasoconstrictor properties [7]. This study was conducted to compare and evaluate the effects of dexmedetomidine with clonidine as an adjuvant to ropivacaine in supraclavicular brachial plexus block for the upper limb surgeries in terms of onset, duration of the block, and post-operative analgesia.

METHODS

After receiving Institutional Ethics Committee clearance and registration with the Clinical Trials Registry of India (CTRI/2021/05/033667, registered on 18/05/2021), this prospective comparative study was carried out.

Inclusion criteria

The following criteria were included in the study:

- Patients in the age group of 18–65 years of both gender
- American Society of Anesthesiologists Physical Status I and II patients
- Posted for various elective upper limb procedures planned under supraclavicular brachial plexus block
- Willingness to give informed consent.

Exclusion criteria

The following criteria were excluded from the study:

- Patient refusal

- Infection at the local site
- Hypersensitivity to local anesthetics
- Coagulation disorders
- Existing neurological disorder/nerve palsy.

After a thorough pre-operative assessment and the routine investigations were reviewed. All the patients were kept nil orally for 8 h before the surgery. In the operation theatre, after securing intravenous access, Lactated Ringer's solution was commenced. After establishing standard monitoring, baseline parameters such as heart rate (HR), blood pressure, electrocardiogram, and oxygen saturation (SpO_2) were recorded. All the necessary equipment and drugs needed for the administration of general anesthesia and emergency resuscitation were kept ready. USG-guided supraclavicular block was performed with 25G and 1.5-inch block needle. The patients were divided into two groups at random, each with 30 patients. For the block, patients in Groups C and D received 0.5% ropivacaine 30 ml with clonidine 1 μg/kg and 0.5% ropivacaine 30 ml with dexmedetomidine 1 μg/kg, respectively.

Sensory and motor block assessment was done every minute till the complete effect was achieved. The onset of the sensory blockade was defined as the time interval between the injection of local anesthetic and the abolition of pinprick response. The duration of sensory block was defined as the time interval between the end of local anesthetic administration and the complete resolution of anesthesia on all four nerves (median, ulnar, radial, and musculocutaneous). The onset of a motor blockade was defined as the interval between the times of injection of a drug to development of motor weakness in the blocked limb. Duration of motor block was defined as the time interval from the onset to the recovery of complete motor function. Duration of analgesia is defined as the time interval from the onset of sensory block to the need for the first rescue analgesia. Sedation was assessed by Ramsay sedation score.

Pulse rate, mean arterial pressure, respiratory rate, SpO_2, and level of sedation were recorded before giving the block, immediately after giving the block then at 5 min, 10 min, 15 min, and 30 min intervals thereafter every 30 min till the end of surgery. Patients were observed adverse effects such as hypotension (drop in blood pressure >20% from baseline), bradycardia (beat <60/min), respiratory depression (SpO_2 <90%) or respiratory rate <10/min, nausea, vomiting, hypersensitivity, and local anesthetic toxicity. Postoperatively, pulse rate, blood pressure, and respiratory rate, SpO_2, level of sedation, the effect of sensory and motor block, and post-operative analgesia visual analog score (VAS) were monitored immediately after shifting the patient in the post-operative ward and then every hourly for 12 h. Post-operative analgesia was assessed using a 10-point VAS. A 10 cm scaled line with 0–10 markings was shown to patients and explained that zero represents no pain and ten represents the worst pain they can imagine. The duration of analgesia was described as the time until the need for rescue analgesia. The rescue analgesic used was Inj. diclofenac sodium 1.5 mg/kg i.v. when the VAS was >4.

Statistical analysis

Statistical tests and analysis were done using Statistical Package for the Social Sciences (SPSS, version 20; SPSS Inc., Chicago, Illinois, USA). Normally distributed continuous data were analyzed using the student t-test. Non-normally distributed continuous data and ordinal data were analyzed using the Mann–Whitney test. Categorical data were analyzed using Chi-square or Fisher exact whichever is appropriate. P<0.05 was considered to be significant.

RESULTS

The clinical and demographic parameters such as age, gender, weight, American Society of Anesthesiologists physical status, and duration of surgery were comparable in both the groups (Table 2) (p>0.05).

There was no statistically significant difference between the groups concerning the onset of sensory and motor blocks (Table 3).

Duration of motor and the sensory block was significantly longer in Group D than in Group C.

There was a significant decrease in pulse rate during the intra-operative period in Group D as compared to Group C (p<0.05). During the post-operative period, the pulse rate was comparable in both groups (p>0.05).

There was a significant decrease in systolic blood pressure (SBP) and diastolic blood pressure (DBP) at 30, 60, and 90 min in Group D as compared to Group C (p<0.05). During the post-operative period, SBP and DBP were comparable in both groups (p>0.05). No decline in SpO_2 was noted.

The sedation score was comparable throughout the study period. Post-operative analgesia was significantly prolonged in Group D as compared to Group C.

Meantime for first rescue analgesic requirement for Group D is also longer than that in Group C.

None of the side effects was noted in either of the groups.

DISCUSSION

Supraclavicular approach to brachial plexus block involves an injection of a local anesthetic around the divisions of the brachial plexus deep to the prevertebral fascia posterolateral to the subclavian artery. Due to the compact arrangement of all the three trunks of the plexus in this region, this block provides complete regional anesthesia for the surgeries on the distal arm, elbow, forearm, wrist, or hand. To induce a fast, dense, and persistent block in the brachial plexus, several adjuvants with

Table 1: Ramsay sedation score [8]

Definition	Score
Patient is anxious and agitated or restless or both	1
Patient is cooperative, oriented, and calm	2
Patient responds to commands only	3
Patient exhibits brisk response to light glabellar tap or loud auditory stimulus	4
Patient exhibits a sluggish response to light glabellar tap or loud auditory stimulus	5
Patient exhibits no response	6

Table 2: Demographic data

Parameter	Group C	Group D
Sex (M/F)	17/13	16/14
Age (years)	43.46±14.80	37.76±13.42
Weight (kg)	58.26±4.67	58.16±7.41
ASA Grade (I/II)	16/14	19/11
Duration of surgery (min)	107.93±36	123.7±33.73

Table 3: Onset of sensory and motor block (Mean±SD)

Parameter	Group C	Group D	p-value
Onset of sensory block (min)	9.60±0.92	9.20±0.92	0.09
Onset of motor block (min)	12.36±0.94	11.96±1.03	0.12

Table 4: Time for first rescue analgesia

Parameter	Group C Mean±SD	Group D Mean±SD	p-value
Meantime of first rescue analgesic (min)	414.86±7.12	605.03±9.88	<0.0001

Our study findings were comparable and similar to a study carried out by Sebastian *et al.* [17] and Karthic *et al.* [18] conducted their study of adding dexmedetomidine and clonidine as adjuvants to levobupivacaine in supraclavicular brachial plexus block and observed HR to decrease from baseline in both his study groups but did not fall below 60 beats/min. In our study, the duration of analgesia was recorded up to the time of need for the first rescue analgesia. The duration of pain relief was found to be significantly longer in Group D compared to Group C.

As a result of comparing dexmedetomidine and clonidine with LAs by Kanvee *et al.* [15] for blockade of the clavicle brachial plexus, it was found that the analgesia lasted longer in Group D than in Group C. In a study comparing dexmedetomidine and clonidine with ropivacaine in supraclavicular brachial plexus block, Sebastian *et al.* [17] found that dexmedetomidine produced longer post-operative analgesia in terms of delayed requirement of first rescue analgesic than clonidine.

Thus, we conclude that, in addition to analgesic properties, the added benefits of conscious sedation, hemodynamic stability, and the absence of significant side effects such as respiratory depression make dexmedetomidine and clonidine an appealing choice as an adjuvant for peripheral nerve block, with dexmedetomidine being a superior choice.

CONCLUSION

Dexmedetomidine prolongs the duration of sensory and motor block as well as the duration of post-operative analgesia as compared to clonidine when used as an adjuvant to ropivacaine in supraclavicular brachial plexus block. The added advantage of conscious sedation, hemodynamic stability, and lack of significant side effects makes dexmedetomidine captivating preference as an adjuvant for peripheral nerve block.

AUTHORS CONTRIBUTION

Dr. Nagalingam Natarajan – Design, writing the manuscript, and interpretation of data. Dr. Gopalakrishnan Kuppusamy – Concept, manuscript review, and final approval. Dr. Aishwarya Ramanathan – Definition of intellectual content and literature search. Dr. Smitul Dave – Writing the manuscript, data collection, and statistical analysis.

CONFLICTS OF INTEREST

None.

AUTHORS FUNDING

No financial interest in any part of the study.

ETHICAL COMMITTEE APPROVAL

Ethical Committee and Clinical trial registry-India approval were obtained.

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Author Queries???

AQ1: Kindly review the sentence as its seems to be incomplete.

AQ2: Kindly cite Figure 1-5 in text part.

AQ3: Kindly cite table 1 and 4 in text part.